Journal of Pioneering Medical Sciences
Received: January 31, 2025 | Accepted: March 03, 2025 | Published: July 05, 2025
Volume 14, Issue 06, Pages 60-67

DOI https://doi.org/10.47310/jpms2025140609

Assessment of Saudi Parents' Knowledge, Barriers and Willingness towards Seasonal Influenza Vaccination among Children in Tabuk City: A Cross-Sectional Study

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Abstract **Background:** Several studies have been conducted in Saudi Arabia on seasonal influenza using adult populations, while limited studies have focused on parents' knowledge of the disease and vaccine, as well as their attitudes and practices toward vaccinating their children against influenza. Therefore, this study investigates the factors that would drive parents to vaccinate their children against influenza. **Materials and Methods:** This study was a cross-sectional observational study conducted in Tabuk City, Saudi Arabia. A simple random sampling method surveyed 404 Saudi parents with at least one child aged six months or older at the time of data collection, from July 1, 2024, to December 17, 2024, using a self-administered questionnaire. The University of Tabuk IRB approved the study (HAP-07-TU-00) and electronic consent was sought from each participant. R was used for statistical analyses, generating odds ratios interpreted with $p<0.05$ as the baseline metric. **Results:** The predictors of overall parental knowledge of influenza were complications (AdjOR = 1.806) and transmission through coughing and sneezing (AdjOR = 0.207). Among fathers, linking influenza with severe disease increased the odds (AdjOR = 3.997), while recognizing coughing and sneezing as transmission modes decreased them (AdjOR = 0.056). Vaccine safety, recommendations for children (AdjOR = 5.130) and administration (AdjOR = 2.051) were strongly associated with vaccine knowledge. While the mothers' model included vaccine timing (AdjOR = 0.729), fathers had higher odds of recognizing vaccine safety (AdjOR = 22.044). Both mothers (AdjOR = 7.091) and fathers (AdjOR = 4.350) showed significant associations with vaccine administration, while attitude strongly predicted vaccination plans (AdjOR = 5.126). **Conclusion:** Parents in Tabuk City have a higher knowledge of influenza and its vaccine, with mothers showing greater knowledge compared to fathers. Factors influencing overall knowledge of influenza disease include its severity, association with serious complications and mode of transmission. Factors influencing knowledge of the influenza vaccine include safety, cohort awareness, recommendations for chronic diseases, vaccine timing and mode of administration. A positive attitude positively influences the vaccination rate.

Key Words Children's Influenza Vaccine, Influenza Knowledge, Vaccine Knowledge, Parental Knowledge, Vaccine Attitude, Vaccine Practice, Saudi Arabia

BACKGROUND

Seasonal influenza, caused by influenza A, B, C or D viruses, is prevalent worldwide and represents a major global concern. It typically strikes during fall and winter. Individuals may experience symptoms such as fever, cough, sore throat, muscle aches and fatigue. While most recover within a week, complications can be severe for pregnant women, children under 5 years of age, older people, individuals with chronic medical conditions (such as chronic cardiac, pulmonary, renal, metabolic, liver or hematologic diseases) and individuals with immunosuppressive conditions/treatments (such as HIV or receiving chemotherapy or steroids) [1,2].

In Saudi Arabia, influenza poses a significant health risk, with thousands of confirmed cases annually. In 2015, Hospital-Based surveillance reported 232 influenza-

associated deaths, which was the highest number ever recorded for the country [3]. Children under the age of five, particularly those under one year old, are at greater risk [4].

Influenza vaccination is an essential preventive measure that not only reduces the incidence of influenza but also minimizes doctor visits, missed work or school days and flu-related hospitalizations in children. The Centers for Disease Control and Prevention recommends that individuals aged six months and older receive an annual influenza vaccination [2,5,6].

In Saudi Arabia, the Ministry of Health (MOH) promotes influenza vaccination by offering vaccines at schools, homes and healthcare centers [7]. Despite efforts to promote vaccination, vaccine hesitancy remains a concern. Parental knowledge and attitudes towards vaccines, including influenza, have a significant impact on childhood vaccination rates [8,9]. Previous research conducted in Saudi Arabia has highlighted the low levels of knowledge and awareness among parents, emphasizing the need for improvement [10-12].

It is crucial to understand the factors contributing to parental vaccine hesitancy. Therefore, this study aims to assess parental knowledge, attitudes and practices towards seasonal influenza vaccination for children in Tabuk, Saudi Arabia. The study will provide insights into the impact of parental awareness on childhood vaccination and may pave the way to enhance healthcare providers' understanding of factors influencing parental decisions.

METHODS

This study is a cross-sectional observation study that took place in Tabuk City, Saudi Arabia. A simple random sampling method, targeted Saudi parents having at least one child aged six months and above at the time of the data collection, from July 1st, 2024, to December 17th, 2024.

The sample size was estimated with an online sample size calculator using a margin of error of 5%, a confidence interval of 95%, response distribution of 50% and depending. The population in Tabuk according to the Saudi Census was 624,000, which estimated the required sample size at 385 participants.

An IRB permission was obtained with reference number UT-423-240-2024 and electronic consent was given for every study participant. R was used for data analysis and logistic regression was used to test significant factors using odds ratios, with a p-value of less than 0.05.

A self-administered questionnaire that had previously been validated by AlOmran *et al.* [13] was used to collect data online. The questionnaire was divided into four parts: sociodemographic characteristics of participants (7 items), parents' knowledge about influenza illness and influenza vaccine (18 items), parents' practice toward influenza vaccine (3 items) and parents' attitude toward influenza vaccine (2 items).

The participants' knowledge was assessed by assigning one point for each correct answer. The total score was calculated by summing the discrete scores of different items in each domain. The knowledge scores ranged from 0 to 18. Overall, scores between 0 and 10 were classified as poor knowledge, while scores between 11 and 18 were classified as good knowledge. Knowledge of influenza disease was assessed separately, with scores ranging from 0 to 3 classified as poor knowledge and scores from 4 to 5 classified as good knowledge. Similarly, knowledge of influenza vaccines was evaluated, with scores ranging from 0 to 7 representing poor knowledge and scores from 8 to 13 indicating good knowledge.

Social Demographic

The following questions were used to assess the demographic characteristics of the study participants: Q1: Are you the father or the mother? Q2: What is your age? Q3: Are you or your spouse a healthcare worker? Q4: What is your education level? Q5: How many children do you have? Q6: What is your child's basic vaccination status? Q7: Does your child have any chronic diseases?

Dependent Variable

The main outcome of the study was represented by Question 16: "Did your child receive the influenza vaccine before?" This outcome was predicted by the following factors: knowledge of influenza disease, knowledge of the influenza vaccine, practice and attitude.

Knowledge of Influenza Disease

Parents' knowledge regarding influenza disease was assessed using the following items:

- Q1: Do you think influenza is a potentially severe disease?
- Q2: Do you believe that influenza causes more deaths than COVID-19 (Coronavirus)?
- Q3: Do you think influenza can lead to serious complications, such as hospitalization and death?
- Q4: Do you think influenza is a highly contagious disease?
- Q5: Do you know that influenza is primarily transmitted through coughing and sneezing?

Knowledge of Influenza Vaccine

Parents' knowledge regarding the influenza vaccine was assessed using the following items:

- Q6: Do you think the influenza vaccine is effective in preventing the flu?
- Q7: Do you think the influenza vaccine is safe?
- Q8: Do you think the influenza vaccine is necessary for children?
- Q9: Do you know the influenza vaccine is recommended for all children 6 months of age and older?
- Q10: Do you think the influenza vaccine is recommended for children with chronic diseases?
- Q11: When is the appropriate time to take the influenza vaccine?
- Q12: How often do you think the influenza vaccine should be taken?
- Q13: How is the vaccine administered?
- Q14: What are the possible side effects of the influenza vaccination?

Practice

Parents' practice regarding seasonal influenza vaccination was measured using the following items:

- Q15: Did you receive the influenza vaccine as a parent?
- Q16: Has your child received the influenza vaccine before?
- Q17: If your answer is "Yes," what influenced you to give your child the influenza vaccine?

Attitude

Parents' attitude regarding seasonal influenza vaccination was assessed using the following items:

- Q18: If your answer is "No," are you planning to give your child the flu vaccine this year or in the future?
- Q19: If your answer is "No," why not?

RESULTS

Descriptive analysis of the study population

The descriptive statistics presented in Table 1 show that 75.7% of the respondents were mothers and 24.3% were fathers. In terms of age, most parents were in the 26-35 years range, representing 36.9%, while the fewest were parents older than 56 years (5.2%).

Notably, 56.5% of the study participants were youthful (≤35 years old). Among the pondents, 18.6% were healthcare workers or had a partner who was a healthcare worker.

Most families had 1-4 children (73.5%), with most having completed a high school level of education (58.2%). A total of 78.5% had their children fully vaccinated for influenza, 16.8% were partially vaccinated and 4.7% were not vaccinated (Table 1). The Chi-Square test shows that parental status ($p = 0.004$) and the number of children ($p = 0.011$) had a statistically significant association with previous child vaccination against influenza.

The overall prevalence of good knowledge about influenza disease and the vaccine was 84.16% (n = 340), while poor knowledge was 15.84% (n = 64). Knowledge of influenza disease showed that 170 participants (42.08%) had poor knowledge, while 234 (57.92%) had good knowledge. The prevalence of knowledge about the influenza vaccine was 14.85% for poor knowledge and 85.15% (n = 344) for good knowledge.

The construct of knowledge was compared based on demographic factors, including parent status, age, healthcare worker status, education, number of children and vaccination status. Regarding the overall score, which comprised the total knowledge score for influenza disease and the vaccine, healthcare worker status was the only significant variable; χ^2 (1) = 6.69, p = 0.010. For knowledge of the influenza vaccine, education was the only significant variable; χ^2 (3) = 8.87, p = 0.031. Regarding knowledge of influenza disease, the only significant variable was healthcare worker status; χ^2 (1) = 9.66, p = 0.002 (Table 2).

Chi-Square Test on Significant Associations on Knowledge, Practice and Attitude towards Influenza Vaccine

Child influenza vaccination had significant associations with knowledge that influenza is a potentially severe disease ($p<0.001$), causes more deaths than COVID-19 ($p = 0.008$), causes serious complications ($p<0.001$) and its transmission is via coughing and sneezing ($p = 0.003$). For more information on the proportions (Table 3).

Child influenza vaccination had significant associations with knowledge of the influenza vaccine (Table 4): As an effective vaccine ($p<0.001$); a safe vaccine ($p<0.001$); a necessary vaccine ($p<0.001$); recommended for children over 6 months of age ($p<0.001$); recommended for children with chronic diseases ($p<0.001$); appropriate time to take

Table 1: The Descriptive Summary and Chi-Square Test of Study Participants

Socio-demographic	Characteristic	Frequency (%)	p-value
Parent	Father	98 (24.3%)	0.004
	Mother	306 (75.7%)	
Age	18-25	79 (19.6%)	0.144
	26-35	149 (36.9%)	
	36-45	108 (26.7%)	
	46-55	47 (11.6%)	
	≥56	21 (5.2%)	
Healthcare Worker	Yes	75 (18.6%)	0.142
	No	329 (81.4%)	
	Less than high	-	
Education	School	79 (19.6%)	0.233
	Diploma	47 (11.6%)	
	High School	235 (58.2%)	
	Postgraduate	43 (10.6%)	
Number of Children	1-4	297 (73.5%)	0.011
	5-7	81 (20%)	
	≥8	26 (6.4%)	
Vaccination Status	Not Vaccinated	19 (4.7%)	0.113
	Partially Vaccinated	68 (16.8%)	
	Fully Vaccinated	317 (78.5%)	

Table 2: Assessment of Overall, Influenza-Specific and Vaccine-Specific Knowledge Score

	Overall, Knowledge			Influenza Knowledge			Vaccine Knowledge		
	Poor (0-10)	Good (11-18)	p-value	Poor (0-3)	Good (4-5)	p-value	Poor (0-7)	Good (8-13)	p-value
Parent									
Mother	52 (81.25%)	254 (74.71%)	0.336	124 (72.94%)	182 (77.78%)	0.316	49 (81.67%)	257 (74.71%)	0.319
Father	12 (18.75%)	86 (25.29%)		46 (27.06%)	52 (22.22%)		11 (18.33%)	87 (25.29%)	
Age									
18-25	7 (10.94%)	72 (21.18%)	0.071	25 (14.71%)	54 (23.08%)	0.231	8 (13.33%)	71 (20.64%)	0.085
26-35	19 (29.69%)	130 (38.24%)		63 (37.06%)	86 (36.75%)		16 (26.67%)	133 (38.66%)	
36-45	22 (34.38%)	86 (25.29%)		48 (28.24%)	60 (25.64%)		21 (35%)	87 (25.29%)	
46-55	11 (17.19%)	36 (10.59%)		23 (13.53%)	24 (10.26%)		11 (18.33%)	36 (10.47%)	
≥56	5 (7.81%)	16 (4.71%)		11 (6.47%)	10 (4.27%)		4 (6.67%)	17 (4.94%)	
HealthCare worker									
No	60 (93.75%)	269 (79.12%)	0.01	143 (84.12%)	186 (79.49%)	0.293	58 (96.67%)	271 (78.78%)	0.002
Yes	4 (6.25%)	71 (20.88%)		27 (15.88%)	48 (20.51%)		2 (3.33%)	73 (21.22%)	
Education									
≤ High School	18 (28.12%)	61 (17.94%)	0.256	36 (21.18%)	43 (18.38%)	0.031	15 (25%)	64 (18.6%)	0.447
Diploma	8 (12.50%)	39 (11.47%)		21 (12.35%)	26 (11.11%)		4 (6.67%)	43 (12.5%)	
Bachelor	33 (51.56%)	202 (59.41%)		104 (61.18%)	131 (55.98%)		34 (56.67%)	201 (58.43%)	
Postgraduate	5 (7.81%)	38 (11.18%)		9 (5.29%)	34 (14.53%)		7 (11.67%)	36 (10.47%)	
No. of Children									
1-4 Children	46 (71.88%)	251 (73.82%)	0.573	123 (72.35%)	174 (74.36%)	0.887	42 (70%)	255 (74.13%)	0.47
5-7 Children	12 (18.75%)	69 (20.29%)		36 (21.18%)	45 (19.23%)		12 (20%)	69 (20.06%)	
≥ 8 Children	6 (9.38%)	20 (5.88%)		11 (6.47%)	15 (6.41%)		6 (10%)	20 (5.81%)	
Vaccination Status									
Fully vaccinated	51 (79.69%)	266 (78.24%)	0.961	133 (78.24%)	184 (78.63%)	0.268	43 (71.67%)	274 (79.65%)	0.245
Not vaccinated	3 (4.69%)	16 (4.71%)		5 (2.94%)	14 (5.98%		5 (8.33%)	14 (4.07%)	
Partially vaccinated	10 (15.62%)	58 (17.06%)		32 (18.82%)	36 (15.38%)		12 (20%)	56 (16.28%)	

Table 3: The Chi-Square Test on Knowledge of Influenza Disease

Knowledge of Influenza Disease		Outcome: Child Vaccinated Before		
		Yes	No	p-value
Potentially a Severe Disease	No	28 (6.9%)	92 (22.8%)	<0.001
	Yes	120 (43.2%)	164 (40.6%)	
Causes More Deaths than COVID-19	No	73 (18.1%)	161 (39.9%)	0.008
	Yes	75 (18.6%)	95 (23.5%)	
Causes Serious complications	No	32 (7.9%)	101 (25%)	<0.001
	Yes	116 (28.7%)	115 (38.4%)	
Transmission via Coughing & Sneezing	No	14 (3.5%)	7 (1.7%)	0.003
	Yes	134 (33.2%)	249 (61.6%)	

the vaccine (p<0.001); frequency of taking the vaccine (p = 0.001) and mode of administration of the vaccine (p<0.001).

Trust in Saudi MOH information and trust in Saudi doctors regarding matters related to influenza had no statistically significant association with past vaccination of children against influenza. However, a significant association was observed with factors influencing child vaccination (p<0.001) and plans to vaccinate the child soon (p<0.001). Most parents who had vaccinated their children against influenza did so under the directive of the Saudi MOH (30.5%) or based on the doctor's advice (20.8%) (Table 5).

Multivariate Statistics

The present study focused on Saudi parents' knowledge, barriers and willingness towards seasonal influenza vaccination for children in Tabuk City. All statistically significant independent variables from the Chi-Square test were included in the logistic regression for further analysis. Binary coding was applied to the dependent variable, "Did your child receive the influenza vaccine before?" with the codes 'Not Vaccinated' (0) and 'Vaccinated' (1). This approach allowed the study to analyze factors influencing parental decision-making regarding the initiation of influenza vaccination.

Knowledge of Influenza Disease

Table 6 presents the logistic regression results with previous child vaccination as the predictor. Parents' knowledge of complications associated with influenza (AdjOR = 1.806; 95% CI: 1.008-3.278) and knowledge of transmission through coughing

Table 4: The Chi-Square Test on Knowledge of Influenza Vaccine

Knowledge of Influenza Vaccine		Outcome: Child Vaccinated Before		
		Yes	No	p-value
Effective Vaccine	No	21 (5.2%)	77 (19.1%)	<0.001
	Yes	127 (31.4%)	179 (44.3%)	
Safe Vaccine	No	21 (5.2%)	145 (35.9%)	<0.001
	Yes	127 (31.4%)	111 (27.5%)	
Necessary Vaccine	No	22 (5.4%)	105 (26%)	<0.001
	Yes	126 (45.5%)	151 (37.4%)	
Recommended for ≥ 6months & Older	No	19 (4.7%)	145 (35.9%)	<0.001
	Yes	129 (31.9%)	111 (27.5%)	
Recommended for children with Chronic Diseases	No	48 (11.9%)	138 (34.2%)	<0.001
	Yes	100 (24.8%)	118 (29.2%)	
Appropriate Time to Take Vaccine	1	111 (27.5%)	154 (38.1%)	0.001
	2	6 (1.5%)	5 (1.2%)	
	3	18 (4.5%)	34 (8.4%)	
	4	13 (3.2%)	63 (15.6%)	
Frequency of Taking Vaccine	A	7 (1.7%)	68 (16.8%)	<0.001
	B	14 (3.5%)	32 (7.9%)	
	C	27 (6.7%)	18 (4.5%)	
	D	90 (22.3%)	128 (31.7%)	
	E	10 (2.5%)	10 (2.5%)	
Mode Vaccine Administration	F	15 (3.7%)	67 (16.6%)	<0.001
	G	118 (29.2%)	179 (44.3%)	
	H	9 (2.2%)	4 (1%)	
	I	6 (1.5%)	6 (1.5%)	

Notes: 1 indicates "Before influenza season," 2 indicates "Directly after influenza season," 3 indicates "During influenza season," and 4 indicates "No need for vaccine." A stands for "Never," B stands for "Once in a lifetime," C stands for "Every 6 months," D stands for "Yearly," and E stands for "Over 5 years." F stands for "I don't know," G stands for "Injection," H stands for "Mouth drop" and I stands for "Nasal drop."

Table 5: Chi-Square Test on Practice and Attitude Towards Influenza Vaccine

Practice and Attitude		Outcome: Child Vaccinated Before		
		Yes	No	p-value
Trust Saudi MOH Information	No	15 (3.7%)	30 (7.4%)	0.626
	Yes	133 (37%)	226 (60.3%)	
Trust Saudi Doctors	No	20 (5%)	42 (10.4%)	0.437
	Yes	128 (31.7%)	214 (53%)	
What influences Child Vaccination	1	47 (20.8%)	14 (6.2%)	<0.001
	2	69 (30.5%)	30 (13.3%)	
	3	11 (4.9%)	22 (9.7%)	
	4	18 (8%)	15 (6.6%)	
Planning to Vaccinate a Child	No	22 (6.3%)	142 (40.9%)	<0.001
	Yes	81 (23.3%)	102 (29.4%)	

Notes: 1 indicates "Doctor's advice," 2 indicates "Saudi MOH directive," 3 indicates "Available and free" and 4 indicates "Fear of COVID-19 experience."

Table 6: Significant Independent Variables and Knowledge of Influenza Disease

Predictors	Overall Model (1)	Father (2)	Mother (3)
(1). Severe Disease	0.590* (0.052)	1.386** (0.022)	0.250 (0.489)
(2). More Deaths	0.109 (0.655)	-0.767 (0.179)	0.316 (0.259)
(3). Serious Complications	0.591** (0.049)	0.950* (0.119)	0.671* (0.065)
(4). Coughing and Sneezing	-1.577*** (0.002)	-2.882** (0.011)	-0.877 (0.174)
Constant	0.047 (0.926)	1.352 (0.227)	-0.695 (0.280)
Observations	404	98	306
Log Likelihood	-250.856	-57.346	-186.137
Akaike Inf. Crit.	511.713	124.692	382.274

Notes: Significance levels *p<0.1, **p<0.05, ***p<0.01, The p-values are enclosed in parentheses, while the beta coefficients are in bold with asterisks indicating significance. Outcome = Child Vaccinated Before

and sneezing (AdjOR = 0.207; 99% CI: 0.073-0.531) were the only significant predictors in the overall model.

When comparing fathers and mothers, only the findings for fathers were significant. Fathers who associated influenza with severe disease had higher odds (AdjOR = 3.997; 95% CI: 1.271-13.814), while those who identified coughing and sneezing as a mode of transmission had lower odds (AdjOR = 0.056; 95% CI: 0.003-0.360).

Knowledge of Influenza Vaccine

The overall model showed a significant association with knowledge that the influenza vaccine is safe (AdjOR = 5.910; 99% CI: 2.858-12.922), knowledge that the vaccine is recommended for children aged 6 months and above (AdjOR = 5.319; 99% CI: 2.983-9.851) and knowledge of vaccine administration (AdjOR = 2.051; 99% CI: 1.338-3.222), which were the only significant predictors in the overall model (Table 7).

Table 7: Significant Independent Variables and Knowledge of the Influenza Vaccine

Predictors	Overall Model (1)	Father (2)	Mother (3)
(1) Effective Vaccine	-0.762* (0.086)	-1.449 (0.175)	-0.675 (0.188)
(2) Safe Vaccine	1.777*** (0.00001)	3.093*** (0.001)	1.327* (0.003)
(3) Necessary Vaccine	-0.138 (0.719)	-0.299 (0.725)	-0.035 (0.939)
(4) Recommended: ≥6 months	1.671*** (<0.001)	2.551*** (0.003)	1.614*** (0.00001)
(5) Recommended: Chronic Disease	0.307 (0.256)	1.588** (0.013)	-0.044 (0.891)
(6) Vaccine Timing	-0.161 (0.215)	-0.017 (0.957)	-0.316** (0.047)
(7) Vaccine Frequency	0.069 (0.633)	-0.010 (0.978)	0.087 (0.593)
(8) Vaccine Administration	0.718*** (0.002)	0.854 (0.103)	0.633** (0.011)
Constant	-3.700*** (<0.001)	-5.200*** (0.003)	-3.058*** (0.0002)
Observations	404	98	306
Log Likelihood	-198.974	-38.741	-151.516
Akaike Inf. Crit.	415.948	95.481	321.032

Notes: Significance levels *p<0.1, **p<0.05, ***p<0.01, The p-values are enclosed in parentheses, while the beta coefficients are in bold with asterisks indicating significance

The model for fathers showed a significant association with knowledge that the influenza vaccine is safe (AdjOR = 22.044; 99% CI: 4.118-163.95), knowledge that the vaccine is recommended for children aged 6 months and above (AdjOR = 12.816; 99% CI: 2.830-83.967) and knowledge of influenza as a chronic disease (AdjOR = 4.895; 95% CI: 1.463-18.129), which were the only significant predictors.

The model for mothers showed a significant association with knowledge that the influenza vaccine is safe (AdjOR = 3.770; 99% CI: 1.652-9.163), knowledge that the vaccine is recommended for children aged 6 months and above (AdjOR = 5.022; 99% CI: 2.592-10.193), knowledge of vaccine timing (AdjOR = 0.729; 95% CI: 0.531-0.990) and knowledge of vaccine administration (AdjOR = 1.883; 95% CI: 1.168-3.118), which were the only significant predictors.

Practise and Attitude

Regarding attitude, as shown in Table 8, all models were significant only for the vaccination plan. The overall model showed a significant association (AdjOR = 5.126; 99% CI: 3.046-8.923), the fathers' model for vaccine administration (AdjOR = 7.091; 99% CI: 2.508-23.636) and the mothers' model for vaccine administration (AdjOR = 4.350; 95% CI: 2.385-8.265).

DISCUSSION

This paper assessed parental knowledge, attitudes and practices regarding seasonal influenza vaccination for children in Tabuk, Saudi Arabia. In 2015, Abdalla *et al.* [3] documented 232 influenza-related deaths under hospital-based surveillance, while a previous study by Nair *et al.* [4] identified influenza as a serious illness among children under one year of age. Three-quarters of the parents were mothers 75.7% and the rest were fathers 24.3%, which shows that the study was more skewed towards mothers. In terms of age, 83.2% represented parents aged 35 years and below, an indication that majority of the study population comprised of youthful parents.

Knowledge of influenza disease

The data from the present study showed that when considering knowledge of both influenza as a disease and the influenza vaccine, 84.16% of parents had good knowledge. This was higher than the 64.5% reported by Alhatim *et al.* [14], 73.3% reported by Alshammari *et al.* [15] but was close to the 83.2% reported by Sales *et al.* [16] and the 89.6% reported by Alshammari *et al.* [17] in Saudi Arabia.

However, knowledge of influenza disease was 57.92%, while knowledge of the influenza vaccine was 85.15%. Overall, the results indicated that 317 (78.47%) of the children were fully vaccinated, 68 (16.83%) were partially vaccinated and 19 (4.7%) were not vaccinated. The percentage of fully vaccinated children (78.47%) was close to the 80% reported by AlOmran *et al.* [13], indicating a high level of compliance with the National Immunization Schedule in the Kingdom of Saudi Arabia. In their study on asthmatic children, Al-Qerem *et al.* [18] reported that 60.4% of children treated at the respiratory clinics in Jordan University Hospital and King Abdullah Hospital had never received the flu vaccine, a figure higher than the 4.7% reported in the present study.

Regarding knowledge of influenza disease, the study showed that parents who understood the serious complications of influenza were more likely to vaccinate their children. This finding is similar to that of Al-Qerem *et al.* [18], who noted that parents who had received the influenza vaccine had higher odds of vaccinating their children compared to those who had never received any vaccine.

However, it was concerning that parents who were unlikely to vaccinate their children still had knowledge of influenza transmission through coughing and sneezing. Differences between parents were evident, as the perceived severity of influenza prompted more fathers to vaccinate their children compared to mothers. However, knowledge of influenza transmission through coughing and sneezing was less likely to motivate fathers to vaccinate their children-a clear indication of a gap that requires further intervention to influence parental vaccination decisions.

Knowledge on Influenza Vaccine

The present study reported knowledge of the influenza vaccine at 85.15%, which was higher than the 73.3% reported by Alhatim *et al.* [14]. Knowledge of the influenza vaccine influenced parents' decisions to vaccinate their children, similar to the findings of Al-Qerem *et al.* [18], who reported that children of vaccinated parents had higher odds of also getting vaccinated.

In the present study, overall, mothers had good knowledge (254, 74.7%) compared to fathers (86, 25.3%). Regarding influenza knowledge, mothers had good knowledge (182, 77.8%), compared to fathers (52, 22.2%). Similarly, for vaccine knowledge, mothers had good knowledge (257, 74.7%), compared to fathers (87, 25.4%).

Vaccination safety, awareness that the vaccine is intended for children aged six months and older and its mode of administration were found to impact parental decisions regarding influenza vaccination. Parental knowledge of vaccine safety and the appropriate cohort for vaccination significantly influenced their decision positively. Specifically, understanding that influenza could lead to long-term illness increased the likelihood of fathers vaccinating their children. These findings are in agreement with the study by Ahmed *et al.* [19] in Sana'a, Yemen, which noted that the safety and efficacy of the influenza vaccine would motivate parents to vaccinate their children.

Additionally, mothers were more attentive to vaccination schedules, as evidenced by the study results, which confirmed that mothers' awareness of optimal vaccination timing and administration methods made them more likely to vaccinate their children. These findings correspond to Al-Binali *et al.* [20], who reported higher knowledge scores in Saudi Arabia among mothers (71.6%) compared to fathers (67%).

Knowledge of influenza disease and the vaccine was influenced by factors such as parenthood (mother or father), age, occupation as a healthcare worker, level of education, number of children and vaccination history. The study showed that parents who were healthcare workers had significantly better overall and vaccine-specific knowledge about influenza. This suggests that parents working in the healthcare sector are in a better position to have higher overall knowledge scores and a deeper understanding of vaccines compared to those outside the healthcare field. Knowledge of influenza was significantly influenced by the level of education, with variations in education levels leading to significant differences in how parents understand influenza as a disease. However, education had no impact on overall or influenza vaccine-specific knowledge.

Practice and Attitude

Regarding attitude, the vaccination plan was the only significant factor. The overall results on knowledge showed that a positive attitude toward the vaccination plan made parents five times more likely to support influenza vaccination. This finding is in agreement with the studies by Abu-Rish *et al.* [21] in Jordan, Alolayan *et al.* [10] in Saudi Arabia and Choucair *et al.* [22] in Beirut, which reported that a positive attitude toward the influenza vaccine would drive parents to get their children vaccinated.

Fathers with a positive attitude toward the influenza vaccination plan were seven times more likely to vaccinate their children, while mothers with a positive attitude were four times more likely to do so.

Practical Implications and Recommendations

Both parents scored differently on knowledge of influenza disease and knowledge of the influenza vaccine, indicating variations in parental influences on vaccination decisions. The study highlighted the importance of awareness as an intervention to educate parents on the safety of the influenza vaccine, its timing and cohort recommendations, aiming to increase vaccination knowledge beyond the current overall score of 84.16%.

Likewise, the study noted that healthcare experience and education play a significant role in the comprehension of influenza and its vaccination. This underscores the importance of awareness efforts directed toward the public to increase vaccination rates based on the National Vaccination Schedules in the Kingdom of Saudi Arabia.

The findings highlight the importance of a supportive attitude toward the influenza vaccination plan, as it has demonstrated its potential to influence parents' willingness to vaccinate their children, with fathers being more influenced than mothers. Therefore, when designing intervention programs to promote influenza vaccine awareness and campaigns, these programs must target behavioural and attitudinal changes among the public.

CONCLUSIONS

The paper concludes that the percentage of parents with good knowledge of influenza vaccination in Tabuk City is high-84.16%. Knowledge of influenza disease is significantly associated with its severity, its association with serious complications and its transmission through coughs and sneezes. Knowledge of influenza vaccines is significantly associated with their safety, awareness of the appropriate cohort to receive the vaccine, recommendations for children with chronic diseases, vaccine timing and the mode of vaccine administration. A positive attitude towards the vaccination plan increases the vaccination rate. Lastly, parents working as healthcare workers are significantly more likely to vaccinate their children compared to the public, with education showing notable differences in understanding the disease, though it does not influence vaccine-specific knowledge.

Limitations

Despite the valuable insights gained from this study, several limitations should be acknowledged:

- **Cross-Sectional Design:** The study's cross-sectional nature prevents the establishment of causal relationships between parental knowledge, attitudes and vaccination practices
- **Self-Reported Data:** The reliance on self-administered questionnaires may introduce social desirability and recall biases, as participants might overestimate their knowledge or report behaviors they perceive as socially acceptable

Acknowledgement

We extend our heartfelt appreciation to all the research assistants who participated in the data collection process, as well as the residents of the Tabuk region who dedicated their time to responding to the survey questions. Our sincere thanks also go to Mr Edward Mugambi Ireri

ireri76@gmail.com from Smart Health EQUAS Consultants for his valuable support in the data analysis for this study.

REFERENCES

[1] World Health Organization (WHO), Influenza (seasonal) 2025, https://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal). https://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal).

[2] CDC. About influenza 2024, https://www.cdc.gov/flu/about/index.html.

[3] Abdalla, Osman et al. "Hospital-based surveillance of influenza A (H1N1) pdm09 virus in Saudi Arabia, 2010-2016y." Annals of Saudi Medicine, vol. 40, no. 1, February 2020. https://www.annsaudimed.net/doi/abs/10.5144/0256-4947.2020.1.

[4] Nair, Harish et al. "Global burden of respiratory infections due to seasonal influenza in young children: a systematic review and meta-analysis." The Lancet, vol. 378, no. 9807, December 2011, pp. 1917-1930. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(11)61051-9/fulltext?showall=true=.

[5] Grohskopf, Lisa A. "Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2020-21 influenza season." *MMWR. Recommendations and Reports,* vol. 69, no. 8, August 2020, pp. 1-24. https://www.cdc.gov/mmwr/volumes/69/rr/rr6908a1.htm?fbclid=IwAR3jErVXGPxoQBQSi_BPWPWnyeraQ_uvfpi45_bjM6MFOEYX5ZUOzxlU4fM.

[6] Rolfes, Melissa A. *et al.* "Effects of influenza vaccination in the United States during the 2017-2018 influenza season." *Clinical Infectious Diseases,* vol. 69, no. 11, February 2019, pp. 1845-1853. https://academic.oup.com/cid/article-abstract/69/11/1845/5305915.

[7] MOH. *MOH pProvides flu vaccines at homes* 2018, https://tinyurl.com/mrx25ue6. https://tinyurl.com/mrx25ue6.

[8] Hamadah, Reem E. *et al.* "Attitude of parents towards seasonal influenza vaccination for children in Saudi Arabia." *Journal of Family Medicine and Primary Care,* vol. 10, no. 2, 2021, pp. 904-909. https://journals.lww.com/jfmpc/fulltext/2021/10020/attitude_of_parents_towards_seasonal_influenza.51.aspx.

[9] Santibanez, Tammy A. *et al.* "Parental vaccine hesitancy and childhood influenza vaccination." *Pediatrics,* vol. 146, no. 6, December 2020. https://publications.aap.org/pediatrics/article-abstract/146/6/e2020007609/33532.

[10] Alolayan, Abdullah *et al.* "Seasonal influenza vaccination among Saudi children: Parental barriers and willingness to vaccinate their children." *International journal of environmental research and public health,* vol. 16, no. 21, October 2019. https://www.mdpi.com/1660-4601/16/21/4226.

[11] AlOmran, Hanan Ibrahim *et al.* "Exploring parents' knowledge and attitudes towards the influenza vaccine in a rural community of Saudi Arabia." *Journal of Public Health in Africa,* vol. 13, no. 1, October 2022. https://pmc.ncbi.nlm.nih.gov/articles/PMC9202461/.

[12] Alsubaie, Sarah S. *et al.* "Vaccine hesitancy among Saudi parents and its determinants: Result from the WHO SAGE working group on vaccine hesitancy survey tool." *Saudi medical journal,* vol. 40, no. 12, December 2019. https://pmc.ncbi.nlm.nih.gov/articles/PMC6969619/.

[13] AlOmran, Hanan Ibrahim *et al.* "Exploring parents' knowledge and attitudes towards the influenza vaccine in a rural community of Saudi Arabia." *Journal of Public Health in Africa,* vol. 13, no. 1, October 2022. https://pmc.ncbi.nlm.nih.gov/articles/PMC9202461/.

[14] Alhatim, Norah *et al.* "Knowledge, attitude and practice of seasonal influenza and influenza vaccine immunization among people visiting primary healthcare centers in Riyadh, Saudi Arabia." *PLoS One,* vol. 17, no. 4, 2022. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0266440.

[15] Alshammari, Shuaa Z. *et al.* "Parental awareness and attitude about childhood immunization in Riyadh, Saudi Arabia: a cross-sectional study." *International Journal of Environmental Research and Public Health,* vol. 18, no. 16, August 2021. https://www.mdpi.com/1660-4601/18/16/8455.

[16] Sales, Ibrahim A. *et al.* "Public knowledge, attitudes and practices toward seasonal influenza vaccine in Saudi Arabia: a cross-sectional study." *International journal of environmental research and public health,* vol. 18, no. 2, January 2021. https://www.mdpi.com/1660-4601/18/2/479.

[17] Alshammari, Thamir M. *et al.* "Healthcare professionals' knowledge, attitude and acceptance of influenza vaccination in Saudi Arabia: a multicenter cross-sectional study." *BMC health services research,* vol. 19, April 2019. https://link.springer.com/article/10.1186/s12913-019-4054-9.

[18] Al-Qerem, Walid *et al.* "Knowledge, attitudes and practices of influenza vaccination among parents of children with asthma: a cross-sectional study." *Vaccines,* vol. 11, no. 6, June 2023. https://www.mdpi.com/2076-393X/11/6/1074.

[19] Ahmed, Wesam S. *et al.* "Attitudes, motivators and barriers toward influenza vaccination for children: a study from a conflict-ridden country." *Conflict and Health,* vol. 18, no. 1, April 2024. https://link.springer.com/article/10.1186/s13031-024-00590-9.

[20] Al-Binali, A. M. *et al.* "Asthma knowledge and behaviours among mothers of asthmatic children in Aseer, south-west Saudi Arabia." *Eastern Mediterranean Health Journal,* vol. 16, no. 11, 2010. https://apps.who.int/iris/bitstream/handle/10665/327668/EMHJ_16_11_2019.pdf?sequence=1#page=51.

[21] Abu-Rish, Eman Y. *et al.* "Knowledge, awareness and practices towards seasonal influenza and its vaccine: implication10.1093/fampra/cmw08610.1093/fampra/cmw086s for future vaccination campaigns in Jordan." *Family Practice,* vol. 33, no. 6, August 2016, pp. 690-697. https://academic.oup.com/fampra/article-abstract/33/6/690/2503165.

[22] Choucair, Khalil *et al.* "Knowledge, perception, attitudes and behavior on influenza immunization and the determinants of vaccination." *Journal of Epidemiology and Global Health,* vol. 11, no. 1, September 2020, pp. 34-41. https://link.springer.com/article/10.2991/jegh.k.200906.001.